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METHOD AND DEVICE FOR WAKING USERS OF A BUS SYSTEM, AND CORRESPONDING USERS

Background Information

Control devices in a motor vehicle are increasingly supplied with voltage on a continuous basis (also referred to as clamp 30 capability) in order to be able to execute certain monitoring and control functions even when the ignition is shut off. This may involve an access and entry authorization or a diagnosis case, for example. To reduce energy consumption, the control devices are brought into a so-called sleep mode. This is done either by switching off the voltage regulator or by entering a corresponding operating mode of the micro-controller.

When required, the control device must be awakened. This is accomplished either via a line to a wake-up input of the user's micro-controller provided for this purpose, or to a wake-up input of the voltage regulator. In the systems used today, which are generally networked, this may also occur by activity on the bus lines.

This has the disadvantage that either a separate wake-up line must be provided to all required control devices, or, in the case of a wake-up via the bus, all control devices, even those not required, are reactivated by intended or unintended bus activity, either by communication on the bus or by interference on the bus.

It is an object of the present invention to selectively wake up only those control devices that are needed to carry out the required functions, using the bus utilized in motor vehicles, in particular a CAN bus.

Summary Of The Invention

The present invention is based on a method and a device for waking up users of a bus system, a counter being provided which counts at least one predefined signal feature of the signals transmitted on the bus system and initiates the further wake-up procedure once a preselectable number has been reached.

In an advantageous manner, an edge or an edge change of the signal is provided as preselected signal feature.

It is also possible for a signal level or a certain combination of several signal levels to be conveniently provided as preselected signal feature.

Especially advantageous is that a time duration is determined in response to the first occurrence of the signal feature and that, from the time duration thus determined following the first occurrence relative to the time duration, binary information results that allows a selective wake-up of users of the bus system.

It is also possible to gather the user to be awakened from the obtained information; this may also be accomplished by the renewed transmission of another wake-up notification or message.

In an advantageous manner, the control devices connected to the bus may thus shut off their micro-controllers altogether or bring them into a sleep mode with a likewise switched-off clock generator; only the transceiver connected to the bus, in particular a CAN transceiver having minimal power consumption, must be supplied with stand-by power. By using the time duration, which is freely selectable, the decoding may be implemented independently of the utilized transmission rate of the bus system. In addition, the evaluation makes it possible to detect errors in the block structure with respect to the communication blocks in the bus system.

<u>Brief Description Of The Drawings</u>

Figure 1 shows a bus system having a plurality of users, at least two users.

Figure 2 shows a method sequence according to the present invention, in the form of a flow chart.

Figure 3 shows, by way of example, a message having wake-up information encoded in the data field.

Figure 4 shows the configuration, according to the present invention, of a block in the data field to determine the signal feature, with encoded information.

Detailed Description

Figure 1 shows a bus system 100 with bus users 101, 102 and 103. These each include an implementing unit 107, 108 and 109, respectively, as well as a time-detection component or counter component or counter 104, 105 or 106. As already mentioned, in this exemplary embodiment only those control device required to carry out the required functions are to be selectively awakened, via the CAN bus often used in motor vehicles. In doing so, a grouping of devices that respond to the same wake-up information is possible too.

One possibility would be to use certain parts of a message/ CAN frame (identifiers, for example) for the selection. However, this requires that the wake-up device is permanently connected to a clock generator, which, however, contributes considerably to the energy consumption. This type of wake-up requires that the transmission rate of the bus be known and that the clock generator have only very slight fluctuations in response to external influences, such as supply voltage or temperature etc. Consequently, the precise objective is to use or develop a selection method that operates in multiple steps and does not require a clock generator in the first step.

The control devices, or users 101, 102 and 103, connected to the bus may switch off their micro-controllers completely or bring them into a sleep mode with a switched-off clock generator. Only the CAN transceiver, i.e., the user having the lowest power consumption, user 101 in this case, for example, is supplied with stand-by power.

The selection mechanism is activated only when a characteristic signal is detected on the bus, and it is possible to activate the micro-controllers, for example, and/or additional voltage regulators of users 102 and 103, respectively.

The present invention may be designed equally as a one-step or as a two-step wake-up concept so as to further increase the waking reliability.

If a plurality of devices respond to the same wake-up mechanisms, i.e., to the same characteristic signals, entire device groups are able to be awakened, or the devices be combined into groups or special devices be awakened for special applications as well.

Due to the configuration of the logic, the information may be extracted from the message regardless of the used transmission rate, as will be explained in greater detail below. In the process, the number of changes between high and low or 0 and 1, i.e., the binary information, is largely constant.

It is especially preferred when the wake-up message is a message configured according to the CAN bus ISO standard. This message does not violate this standard and thus does not cause any problems in existing systems. A CAN controller, as it is used in other approaches, will then not be necessary.

It is especially advantageous that, following the initiation of the further wake-up procedure, the message is sent again and it is determined on this basis which users are to be selected for a complete wake-up.

Figure 2 shows the basic flow diagram as an example. The transmitter of the wake-up request sends a message A according to Figure 3 on the bus in which the receiver or the receiver group to be awakened is encoded by a number, as in a CAN bus in the example shown. In the sleep mode, the bus is recessive. When the first message arrives, which may be detected by the change to dominant occurring in block 1 of Figure 2, and by which a counter or the time acquisition is activated. Over a certain time period, which is influenced by several factors, the number of edges or signal levels as well, that is, of the message having n pulses, is counted in block 2 of Figure 2. If this number is within the permissible limits, the second part of the circuit is activated. This results in a first separation of communication or interference on the

bus and a wake-up request. If this comparison is positive, i.e,, if a wake-up request is involved, the second step of the logic is energized. The transmitter now sends message A according to Figure 3 for the second time. The wake-up logic, that is, the processing unit, in particular, then reads out from the message the number of the device or the device group that is to be awakened. This takes place in block 3 of Figure 2. If the read-out number matches a stored number, the device is activated via activation of the voltage regulators or via waking of the micro-controller in block 4 of Figure 2, and the corresponding user takes part in the bus traffic. The combination of blocks 2 and 3, as described before, is shown in this flow diagram. It is also possible to use only one of the two steps as wake-up criteria.

According to Figure 3, message A is used in a preferred form as a message configured as CAN bus ISO standard. Provided are a start of frame, SOF, an arbitration field, which usually includes the identifier, and a control field before the data field. Included after the data field are a check number as cyclic redundancy check, CRC, and a confirmation field regarding the message transmission, an acknowledgment ACK. Message A includes the number of the device or the device group in the data field. The wake-up ID may be used as CAN identifier, that is, rrr rrrd rrrr according to CAN specification 2.0, r denoting recessive and d dominant. In this way, the frame corresponds to the CAN bus specification, and the communication of other devices via the CAN bus is not disturbed.

As shown in Figure 3, the entire data field in the frame, in particular in the CAN frame, is made up of 64 bits in this case, subdivided into 8 blocks, namely block 0 to block 7. Encoded in each block is at least 1 bit of the device number. If exactly 1 bit of the device number is encoded in each block, the circuit is able, as shown, to obtain 8 bits from a CAN frame for the further processing. Due to the nesting of these 8 bits, errors in the transmission may be detected.

The special configuration of the individual blocks 0 through 7 from Figure 3 is shown in Figure 4. Due to this special configuration of the 8 blocks, the encoding can occur independently of the chosen transmission rate of the bus. In addition, errors in the

block configuration may be detected as well. One block corresponds to 8 bits from the CAN data field.

The configuration of a block is shown in Figure 4 by way of example. Bits 2 and 3 are on high to measure or determine a time t. After bit 3 ends, the wake-up logic or the processing unit waits out the previously determined time t once and stores the state that then occurs; it then waits out time t once again and then again stores the then occurring, renewed state. Time t and 2t, as shown in Figure 4, may be selected such that a full high or low signal may be detected within the framework of the signal levels. In the same way, a detection of the signal edges, from bit 4 to bit 5 and bit 6 to bit 7, is conceivable by appropriate selection of the respective time segments. Regardless of the used transmission rate, this results in an encoding possibility for an 0-information, here in bit 5 and 6, and an 1-information, here via bit 7 and 8.

That means that, in the encoding by way of example in Figure 4, bit 1 is always 0, bit 2 and bit 3 are always 1 for calibrating time (measuring-in time, or metering-in time) t, bit 4 in turn is always 0 for separating the calibration time from the actual binary information. Bit 5 and bit 6 are selected such here that they are on high, which then means a logical 0 for the block. Bits 7 and 8 are then chosen thus, which would mean a logical 1 for the block. In other words, if bits 5 and 6 are on 1, the block contains a logical 0, and if bits 7 and 8 are on 1, the block includes a logical 1. That means that the bits are set in such a way here that either the bits 5 and 6 or the bits 7 and 8 are on 1. Therefore, the method indicated here shows a transmission that is independent of the baud rate, in particular by the counting of edges or edge changes or the corresponding signal levels, respectively, according to the individual, preselected signal feature; in one case, as a first wake-up step and, in the other case, when evaluating a retransmitted message, as a multi-step concept. As already mentioned, the preselected signal feature may be the signal level, that is, 0 or 1, as in the example of Figure 4, or also, as already explained, the evaluation of the signal edges or the change in the signal edge. This results in a simple possibility for the selective wake-up of control devices, without additional line requirements and without always energizing all users of the bus system, even those not required.